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SUBJECT MATTER INDEX OF APPLICATIONS FOR PATENTS.

August 16th to September 15th inclusive.

The following Index gives first the class, then the name of the Inventor, and No. of the application. In this list (com.) means Invention communicated from abroad. Further information as to the progress of these Patents by Notice to Proceed, Sealing, and Specifying, can be obtained at the Office, 21, Cockspur Street, Charing-cross.

Acids.—W. L. Wise (com.), 3976. E. A. Brydges (com.), 4040. C. A. Allison (com.), 4337. G. Jarmay, 4415.

Advertising, Advertisements, &c.—J. Redpath, 4462.

Aerial Machines, Aerostation, Balloons, &c. —J. Imray (com.), 4055.

Air, Gases, and Vapours (Pumping, Forcing, Exhausting, Compressing, &c.)—E. K. Dutton (com.), 4008. E. Quack, 4023. D. Clerk, 4046. S. Griffin, 4080. J. F. McNay and P. J. Harrison, 4165. F. W. Rachholz, 4193. J. H. Ladd, 4242. A. M. Clark (com.), 4260. C. H. Andrew, 4291. W. R. Lake (com.), 4304. E. Duchamps 4336.

Alkalies (Soda, Potash, Lithia, Ammonia.)—T. Kenyon, 3974. A. McDougall, 4001.

Ambulances, &c.—J. N. Burt, 4255.

Augers.—H. J. Haddan (com.), 4050.

Axles, Shafts, Bearings, Journals, Axle Boxes, &c. —S. Pitt (com.), 4044.

Bags, Portmanteaus, Sacks, Holders, Satchels, Reticules, Knapsacks, Valises, &c.—O. Jacobi, 4125. O. Seefelo, 4135.

Bands, Belts, Straps, Chains, and Ropes for Driving Machinery, Belt Shippers, &c.—F. Reddaway, 3975. W. White, 4098.

Baths, Bathing Appliances, Lavatories, &c.—A. J. Boult (com.), 4413.

Beams, Girders, Rafters, &c.—R. Howarth, 4185.

Belts, Braces, Garters, Girths and Bands for Wear.—E. M. Moore, 4327.

Beverages, &c—W. B. Thompson (com.), 4053.

Bobbins, Spools, Reels, Cop-tubes, &c.—G. E. and R. Ashworth, 4325,

Boilers, Coppers, Kiers, &c.—J. and D. Bell, 4203.

Bolts, Pins, Studs, Wrist Pins, &c.—H. H. Lake (com), 4144. W. R. Lake (com.), 4356.

Boots, Shoes, Leggings, Clogs, Cleaning Boots, Boot-jacks, &c.—T. Lilley and W. B. Skinner, 3998. H. H. Lake (com.), 4063. J. W. Jones and E. R. Bridger, 4216. A. Hanniball, 4332. E. Jennings and J. Butcher, 4378. A. J. Boult (com.), 4412.

Boring, Drilling, and Rifling, Gimlets, Augers Drills, Reamers, Boring Bits, Ratchet and other Braces.—W. Heap, 4015. H. J. Haddan (com.), 4050.

Bottles, Bottle-stoppers, Capsules, Bottling and Decanting Liquids, Stopping and Opening Bottles, &c.—D. Rylands and R. Potter, 4018. H. H. Lake (com.), 4058. J. Thompson, 4210. N. Fritzer, 4307. J. Thompson, 4351. J. Phillips, 4398.

Boxes, Cases, Bins, Chests, Trunks &c.—T. Bishop, 4073. J. Pearson and W. F. O. Eriss. 4106. O. Jacobi, 4125. S. E. Edwards, 4133. E. Edwards, 4156. T. Humphreys, 4292. W. W. H. and J. D. Lever, 4331. T. J. Brooks, 4368. E. de Pass (com.), 4404.

Brackets, &c.—A. Barker, 4586.

Braiding Machines, Plaiting Machines, &c.—W. Ashton, 4230.

Bread, Biscuits, &c.—W. A. F. Weighort, 4215.

Breaks for Machinery, Stop Motions, &c.—A. W. L. Reddie (com.), 4049. W. Wilkinson, 4060. J. S. Humberstone, 3990. J. F. Pilkington, 4118. J. Imray (com.), 4175, 4205, 4206.

Boring.—W. P. Thompson (com.), 4053. G. F. Redfern (com.), 4408.

Bricks, Tiles, and Building Blocks, &c.—J. C. Bloomfield, 4308.

Brushes, Brooms, Mops.—A. Harvey (com.), 4041. J. Thompson, 4121.

Buttons, Studs, Sleeve Links, and other Dress Fasteners, Eyelets, Button Holes, Solitaires, &c.—E. G. Colton (com.), 4004. H. H. Lake (com.), 4063. C. Cooper, 4066. E. E. Ashing. 4160. H. J. Haddan (com.), 4386. E. J. Lutham, 4388. A. J. Boult (com.), 4412.

Cans, &c.—R. Strond, 4238.

Carpets, &c.—W. Mitchell, 4081. S. Child, 4330. H. J. Haddan (com.), 4403.

Carriages, Cabs, Omnibuses, Waggons, Carts, Trucks, Perambulators, Barrows, Loading, Unloading, and Tipping Carts, &c.—A. J. Boult, (com.), 3984. T. Briggs, 4112. J. F. Smith, 4157. C. A. Allison (com.), 4338. F. and F. E. Pontifex and W. J. Rosser, 4428.

Cartridges, Cases and Holders, Percussion Caps, &c.—H. H. Lake (com.), 3198. T. P. Wood, 4427.

Casks and Barrels, Cask-stands, Vent-pegs, Tilting Casks, &c.—H. Forman 4082. J. Walker and A. Howell, 4182. R. C. Ekworth, 4340.

Castors, &c.—A. Skinner, 4300.

Castings and Moulding, Plastic Compositions &c.—H. H. Lake (com.), 4144. J. C. Bloomfield, 4308.

Ceilings, &c.—G. M. Edwards, 4127.

Charcoal, Coke, Carbon, Lamp-black, Plumbago, &c.—C. and J. Thomson, 4022. H. Simon (com.), 4239.

Cheques, and other Monetary Documents Cheque-Books, Bank Notes, Forms, Bills, Receipts, Invoices, &c.—J. Auby, 4208. J. M. Black, 4350.

Chlorine.—W, Weldon, 4079.

Cleaning and Polishing, (Miscellaneous) &c. —W. van Praagh, 4305.

Clocks, Watches, Chronometers and other Timekeepers, Watch Keys, &c.—A. Hugueniro, 4132. A. Aubert, 4240. A. J. Boult (com.), 4414. A. G. Hoode, 4420.

Coffee, Cocoa, and Tea; Coffee-pots, Teapots, Urns, &c.—E. de Pass, (com.), 4404.

Combs, &c.—A. M. Clark (com.), 4237. P. Borcks, 4249.

Condensing Gases, Fumes, and Vapours, Condensers, &c.—E. G. Browne, 4093.

Confectionery, Pastry, Sweetmeats, &c.—W. R. Lake (com.), 4389.

Conveyors, &c.—W. B. Dell, 4068.

Copying, Tracing, Drawing, Writing, Rule-Paper, &c.—J. Mowat, 4399.

Cosmetic.—J. Thompson, 4210, 4351.

Crucibles and Melting Pots, &c.—H. E. Newton (com.), 4248. J. Imray (com.), 4379. J. E. Bott, 4574.

Cutting.—A. J. Boult (com.) 3983. N. Arthur, 4065. J. H. Stone, 4085. J. Matthews, 4476. J. Wetter (com.), 4189. J. M. Black, 4350.

Cylinders, &c.—J. T. Chadwick and J. Crossley, 4266. Ellen E. Merrick, 4348. R. Ogden and J. M. Livesey, 4394.

Dentistry, Artificial Teeth, Tooth Powder, &c.—J. J. Wedgewood, 4128.

Disinfecting, Deodorising, Fumigating Apparatus and Compositions, &c.—J. C. Kent, 4109. F. H. Atkins, 4196. J. Ellis, 4233.

Doors, Gates, and Door Furniture.—F. and F. E. Pontifex and W. J. Rosser, 4423.

Drains, Sewers, Gutters, Gratings, Gulleys, Ditches, Traps, Sinks, &c.—J. C. Kent, 4109.

Drying or Desiccating, Expelling Moistures, &c.—J. Wetter (com.), 4170. W. Lawrence, 4285.

Dyeing and Staining.—L. Glover, 4122. H. H. Lake (com.), 4195. D. Haworth and W. H. Anson, 4405.

Dyes, and Printing Colours, Dyeing and Staining, &c.—T. Holliday, 4971. B. J. B. Mills (com.), 4083. J. Imray (com.), 4207. J. Ellis, 4233. A. P. Price (com.), 4428.

Earthenware and Porcelain, Ceramic Ware Terra-cotta, &c.– D. Rylands and R. Potter, 4018. H. Walley, 4034. J. Pickin and C. Goodfellow, 4329.

Electricity, Galvanism, and Magnetism, and their Application.—A. C. Henderson (com.), 3970. R. H. Courtenay, 4037, 4038. G. C. V. Holmes and S. H. Emmens, 4059, 4061. O. C. D. Ross, 4071. S. Pitt (com.), 4136, 4137. L. H. Despeissis, 4148. J. H. Johnson (com.), 4171. H. H. Lake (com.), 4177, 4192, 4276. F. C. Phillips, 4180, D. J. Fitzgerald and T. J. Jones, 4197. E. Edwards (com.), 4219. A. Gutensohn, 4243. F. C. Glasen (com.), 4319. E. P. Chaimsonovitz and T. Rowan, 4345. T. A. B. Putram, 4347. J. John, J. Parsons, and M. F. Purcell, 4365. T. J. Jones and E. C. Rimington, 4416. W. M. Mordey, 4419. T. P. Wood, 4427.

Electric Light.—T. T. Smith, 4104. A. W. Richardson, 4269. J. R. P. Wallace and F. Cherry, 4281. J. W. Swan, 4381.

Electro-Magnetic Engines, &c.—S. Pitt (com.), 4136, 4137.

Enamelling.—J. Pickin and C. Goodfellow, 4329. T. Reeves, 4369.

Engraving and Etching.—J. Mowat, 4399.

Envelopes (Postal).—Aimie E. Wardroper, 3994.

Excavating and Dredging, Embankments and Tunnels, &c.—W. F. Batho, 4268. C. Pieper (com.), 4377.

Explosive Compounds, Nitro-cellulose, Pyroxyline, &c.—J. C. de Castro, 4043.

Extracts, &c.—B. J. Mills (com.), 4053, J. H. Johnson (com.), 4151.

⁂ *The above List is prepared from the Patent Records by Mr. T. Morgan, Secretary of the Inventors' Patentright Association, Limited.*

An improved harrow has been patented by Mr. Even Anderson, of Humboldt, Neb. This invention consists of improved contrivances for extending and contracting a V-shaped harrow, to widen and narrow it to suit different conditions and kinds of plants to be cultivated. The handles are crooked, and they are detachably connected to the bars by clips, enabling them to be taken out and shifted from side to side to range in proper relations to the attendant. whether the harrow be contracted or extended, and the clips are fitted to shift up and down on their pivot, and be fastened by the bolt to alter the pitch of the handles to suit the attendant.

BRITISH MUSEUM

PHILIPP REIS, INVENTOR OF THE TELEPHONE.

By W. C. Barney.

I do not pretend to write a review of this book, a perusal of which cannot fail to prove conclusively, to any unbiased mind, that Philipp Reis was the *inventor of the telephone*; but I make a few remarks upon certain facts established by the contemporary documents, and by "the contemporary witnesses" cited by the author; and with due deference I offer a few comments upon the "review" by your editorial critic, published in your journal of the 4th inst., with whom I disagree *in toto*. Your reviewer says: "In plain words, almost the whole object of the book is to prove that variations of resistance by surface contact between two substances, as applied to telephony, is really the invention of Reis, and the author's arguments to prove his case, although in our opinion *utterly insufficient*, are worthy of an eminent counsel," and he reproaches the author for persistently, again and again, repeating that "electric mechanism, consisting of two or more parts in *loose or imperfect contact with each other*, was an intentional characteristic of the Reis transmitter." Your reviewer proceeds to say, "that the instrument *was* constructed with loose or imperfect contacts is undoubtedly true, but that such was Reis's intention we submit there is no evidence of any reliability to prove." I submit, can any more reliable evidence be required to prove that Reis's *intention* was to construct an instrument with loose or imperfect contacts, than the fact (admitted by your reviewer) that Reis's "instrument was constructed with loose or imperfect contacts;" in fact, the construction of the instrument proves that Reis's intention was to make the contacts of the most loose and imperfect kind—so loose and imperfect are they that their looseness and imperfectness makes the instrument exceedingly sensible to the action of air waves produced by the human voice, so that the *slightest whisper* upon it will cause variations in the strength of the electric current. I submit, have not all the imitators of Reis endeavoured to make a "current regulator" sensitive, so as to avoid the necessity of speaking in a loud tone? How, then, Reis's instrument, in which words spoken in a whisper are reproduced with marvellous accuracy, is objected to, because when words are spoken in a loud tone the articulation is indistinct? I submit that the Reis instrument presents the most beautiful construction of loose and imperfect contacts in a current regulator—a current regulator which will do what no other current regulator, of which I am cognizant, will do, and that is, will reproduce articulate speech in a louder tone than that of the words spoken to it; and to this current regulator only can the term *microphone* be justly applied.

Your reviewer cites the "very fact that Reis chose *platinum* for his contact-points is a proof that he wished to obtain uniformity and completeness in his makes and breaks, and to avoid anything like an imperfect contact." I submit, can there not be *imperfect* contacts between two pieces of platinum? Cannot there be an *imperfect* contact between two pieces of the best metallic conductors? Professor Hughes's beautiful invention of the microphone is constructed on the principle of loose and imperfect contacts, and did he not construct them of metal? Will your reviewer say that Professor Hughes did not intend to construct his microphone with *loose and imperfect contacts*, because he used metals (ay, metals of much greater conductivity than platinum)? Your reviewer says: "That Reis's instrument did transmit articulate speech may be admitted, but that it did so as a result of the inventor's endeavour to produce an *undulatory* current and not an intermittent one we cannot admit," and to sustain his assertion he quotes the following words of Reis himself: "The needle reproduces the tone which was imparted by the *interruption* apparatus." I submit, is not an undulatory current produced by rapid *perfect* makes and breaks? Is not this a daily occurrence with the Morse key, when rapidly operated? Are not the effects of rapid makes and breaks visible to the eye when the Bain system of chemically-prepared paper is used to receive the signals? Is it not well known that the recording chemically-prepared paper presents an unbroken, continuous line—broader and darker at intervals, with a narrower and fainter line connecting the broader and darker marks? Is this not the effect of an undulatory current, produced by perfect makes and breaks? It is then clearly evident that rapid makes and breaks will produce an undulatory current. I submit that it is impossible to make rapid makes and breaks without producing undulations in the current. Now, from the construction of Reis's instrument is it not evident that, even if it made "makes and breaks," they are so rapid that it must produce undulations in the current? in fact, the rapidity with which the makes and breaks would be made by it cannot produce the effect of makes and breaks at the receiving end, which can be easily demonstrated by using a Bain chemically-prepared paper receiver with a Reis instrument. I have made such an experiment on a short line from my laboratory to another room, and I find that even when speaking in a very loud tone to the instrument, the line on the chemical paper presented a uniform breadth and depth of colour, thus demonstrating that although there were actual makes and breaks of the current by the transmitter, yet they were so rapid that the line on the chemically-prepared paper gave very faint signs of the interruption of the current, showing a line darker and lighter alternately.

Reis certainly speaks of the interruption of the current, and I will admit that his instrument will cause makes and breaks, or interruption of the current, but who will presume to say that Reis did not know that such rapid makes and breaks as his instrument will produce, when spoken to in a loud tone, will produce undulation in a current? Does not Reis, in all his writings, speak of "undulating curves," and in his drawings represent various forms of undulating curves? Who is so bold as to assert as a fact that the instrument of Reis, as the microphone of Hughes, does not act through the delicacy of make and break? Professor Blythe, in the Scottish case, on his examination, expressed himself as follows:—

"Speaking popularly, what do you consider the action of the microphone to be?—I am unable to say what the action is, but what appears to me to be the action is the delicacy of the make and break action. It acts through the delicacy of make and break. We know that an interrupted current does produce a musical sound, and we know also that the pitch of the note will depend on the frequency of the interrupting current. Now if we have a sufficiently delicate make and break, it seems to me quite possible, at least not impossible, that an expert might be able to transmit speech, seeing that articulate speech has an accentuated sound.

"You are still of opinion that that is most probably the action of the microphone?—Yes; of course I do not commit myself to saying, without further experiment, that that is the exact theory.

"Is that view confirmed or not by the fact that sparks are noticed upon the carbon pencils of the microphone when it is seen in operation in the dark?—It is; I have seen sparks emitted from the microphone when it is being used as a transmitter, and that indicates that there is more or less of a make and break.

"And you think that when there is a sufficiently delicate apparatus for making and breaking the current, there is no reason to suppose that it may not transmit articulate speech?—They were occasional sparks, and gave evidence of the break at the time I saw them."

Here, then, we have the opinion of Professor Blythe. Other scientific men may entertain a different opinion, but will any of them venture to assert that when there is a sufficiently delicate apparatus, such as Reis's, for making and breaking the current, articulate speech cannot be transmitted?

Your reviewer writes: "Great stress is laid upon the use of the word '*tone*,' which Prof. Thompson points out is the German word 'ton,' and is more nearly equivalent to the English word 'sound,' and includes articulate as well as musical tones. In other words, because articulate speech is included under the expression 'tone,' therefore articulate speech as well as musical tones was certainly meant, an argument which fails to convince us." The scepticism of the reviewer must be great indeed; in fact, incomprehensible. Is it not a maxim that the greater includes the lesser?

These facts are fully established by Professor Thompson by the production of evidence which no unbiased person can refuse to accept:—

1. Reis's telephone was expressly intended to transmit articulate speech.

As proof of this intention of Reis's, Professor Thompson quotes from a prospectus issued by Reis in 1863, these words: "Besides the human voice, according to my experience, there can also be reproduced the tones of good organ pipes and those of a piano." In this same prospectus occur the instructions for the use of the signal call, by which the listener can communicate his wishes to the speaker. These instructions run—one beat=sing; two beats=speech.

2. Reis's telephone, in the hands of Reis and his contemporaries, did transmit speech.

In proof of this fact Professor Thompson cites Professor Quircke, of Heidelberg, who testifies that he heard and understood words spoken through a Reis telephone in 1864. Also Professor Bottger, editor of the *Polytechnischer Journal*, published in 1863, who wrote: "The experimenters could even communicate words to one another." Also several others who give the same testimony, among them Mr. S. M. Yeates, of Dublin, testifies "that in 1865 the instrument was shown at the November meeting of the Dublin Philosophical Society, when singing and words were transmitted."

3. *Reis's telephone will transmit speech.*

In proof of this fact Professor Dolbear, in his paper on "The Telephone," read March, 1882, before the Society of Telegraph Engineers and of Electricians, we find: "The speaker could testify that the instrument would talk, and would talk well." "Reis did transmit and receive articulate speech with his instrument." A great number of persons can testify to this fact; and was not an actual trial of Reis's telephone made openly in court, before Mr. Justice Fry, who said, in giving judgment on the case, "it is perfectly true that there is some evidence before me that Reis's instrument will speak"?

I forbear to add to this already perhaps too lengthy paper further extracts from Professor Thompson's book, especially as those persons interested in this wonderful invention of Philipp Reis's will read the book and judge for themselves.

To Professor Thompson the scientific world owes a debt of gratitude for his indefatigable zeal and well-directed and successful researches in establishing the fact that Philipp Reis was the *inventor of the telephone* and also the further fact that the claims set up by others to that invention are without foundation.—*Electrical Review.*

Electric Lighting in Paris. — The Municipal Council of Paris has voted a credit of £4,000 for the electric lighting of the principal rooms of the Hotel de Ville. The Edison system will be the one adopted.

THE NEW TAY BRIDGE.

On the 28th of December next four years will have elapsed since the central portion of the Tay-bridge fell during a violent storm and a train was precipitated into the river and some 75 persons lost their lives. The exact number of persons who travelled by the train was never ascertained. Positive information was, however, obtained to the effect that 62 passengers were in the train on the memorable night, but only 46 bodies were recovered. Fortunately for the North British Railway Company no one holding high position lost his life, and,in consequence, the compensation claims were small and settled without much difficulty. During the brief time the bridge was available for traffic —it was opened in June, 1878—it had been found of immense advantage. Many were of opinion that no new attempt would be made to bridge the Tay, at least at Dundee, where it is so wide, but the actions of the directors of the company showed that they were not overwhelmed by the terrible disaster of 1879. In the following session of Parliament application was made for an Act authorising the re-construction of the bridge. The company took the highest engineering advice they could get. They consulted Mr. W. H. Barlow, civil engineer, London, and went before a Special Committee of the House of Commons with a scheme prepared by that distinguished engineer. The proposal received the sanction of Parliament, and in July, 1881, the company was at liberty to begin operations. Having secured Parliamentary approbation for a feasible scheme, the next important step was to obtain the services of a qualified contractor. Negotiations were opened with this view, and ultimately arrangements were completed between the company and Messrs. William Arrol and Co., contractors, Glasgow. That firm had successfully completed several gigantic undertakings. They built the new station at Carlisle, and erected for the Caledonian Railway Company a great iron girder bridge over the Clyde. All the viaducts on the Glasgow, Hamilton, and Bothwell Railway, including the bridge which crosses the Clyde near Bothwell at a very high elevation, were completed by Messrs Arrol, and they have recently finished the iron viaduct over the South Esk at Montrose, the length of which is fully a quarter of a mile.

The construction of the new Tay-bridge was begun in March last year. When it is remembered that the bridge across the Tay is probably the longest in the world over water, and that for a considerable distance operations have to be conducted at a point in the river that is navigable for vessels of considerable tonnage, some idea of the difficult character of the work which will devolve on Messrs. Arrol may be imagined. The land brick viaduct on the north side of the river, used in connection with the previous bridge, is to be utilised as part of the new structure, but the new bridge will be 60ft. further up the river than the old one. From the north shore it will go off in a curve, the greater length of it in the river being in a straight line from the south shore. The spans will be 85 in number, nearly corresponding to those of the former bridge, and the total length of the viaduct from the Fife shore to the junction with the brick arches referred to will be 10,545ft. 6in. or within a few feet of two miles. From the Fife shore a start is made at a point 60ft. west of the previous shore abutment. First, there are four brick arches of 50ft. span. As in the old bridge, the central spans will be 13 in number—namely, 11 spans of 245ft. and two of 227ft.

On those spans the line, which will be double throughout, will run on the level of the bottom boom of the girders, as was the case formerly, and the girders will be of the bow-string type, having a *maximum* depth of 28ft. 9in., and a *minimum* depth of 20ft. 3in. The level of the under-member of four of those girders will be 77ft. above mean high-water, being 11ft. lower than in Sir Thomas Bouch's work. To reach the point where the summit level is attained there will be, counting from the brick spans already referred to, one span of 118ft., ten spans of 129ft., and 13 spans of 145ft. The new bridge will be founded on cylinders—those at the north end being of cast iron, and those in the centre of the river and at the south end of wrought iron. Those cylinders vary from 10ft. to 23ft. in diameter. There are two cylinders in each pier, and all will be filled up with cement and concrete. On the south side the bridge joins the main line of the North British Railway and the Newport branch. The junction with those two lines in the old bridge was made by a forked connexion above the water. When the scheme now in course of completion was before Parliament a protest was made against the perpetuation of the mode of connecting the lines which had been adopted in the first bridge. The Parliamentary Committee gave heed to the representations made, and the junction of the bridge and the lines mentioned will now be made above solid brick arches, and there will be no opening between the two lines of rail.

As is nearly always the case with bridge work in the tidal rivers, difficulties with the river bed, neither anticipated nor prepared for in the plan of works, have been encountered. More may yet be met with, but the very capable engineer in charge is of opinion that the builders now know the worst they have to face. A triumph over the uncertain weather, which so much delayed the building of the first bridge, has been gained by the huge pontoons on legs which are used for founding the piers. Those "quadrupeds," two of which are now at work, were quite an experiment on a stormy river like the Tay, but they have proved successful. A "quadruped" consists of a large pontoon with a leg at each corner. The pontoon is floated into a position, and the legs are then allowed to slide down through the pontoon till they touch the ground. Instead of being afloat the pontoon is now fixed to the ground, and by hydraulic jacks is raised out of the water upon its legs, and becomes a stationary platform. From this platform the work of laying the piers is carried on—the cylinders being lowered in their places through two large square holes in the pontoon. After the cylinder has been put down, the mud or sand below it is excavated by means of a mechanical digger. It consists of a large iron trough weighing two-and-a-half tons,the bottom opening outwards. The digger is allowed to drop swiftly into the sand, where it buries itself, and on being drawn up by the crane the bottom closes automatically, and in favourable conditions it lifts as much as two tons of sand. While this process is continued the foundation on which the cylinder rests is lifted away. The cylinder then sinks by its own weight. Guide bars ensure that it sinks perfectly vertically, and from the arrangements there is no possibility of its going off the plumb. As the cylinder sinks down rings of iron are added to the top. The efficiency of the standing platform is felt not only in defying the weather but in enabling the engineers to lay the piers in their exact places—a work which was almost impossible from a movable platform at the mercy of the wind and tide. The power of the digger in the work of excavating easily disposes of all obstacles but boulders and very hard clay, which have to be removed by ordinary processes. The foundations of the piers are being laid with the utmost care. Besides being much broader they are deeper than the foundations of the disused bridge. For some of the foundations already laid, there are from 24 feet to 30 feet of iron cylinder sunk in the river bed. A third "quadruped" of larger dimensions than those in use is being built at Dundee, and a fourth is in the course of construction at the contractor's Glasgow works. No fewer than 19 of the piers are now nearly finished, work going on at each side and in the centre of the river simultaneously and continuously day and night. More than 200 hands are employed. This may seem an insignificant number for so great a work; but it must be borne in mind that the contractors have the most recent machinery at their command, and, in consequence, are able to do with fewer hands, and at the same time to get along more expeditiously. Although nearly one-fourth of the whole of the piers have thus been laid, there are amateur engineers who think that progress hitherto has been uncommonly slow. The Act permitting the erection of the first bridge was passed in 1870, yet it was not till June, 1878, that it was opened for traffic. Considering the short time the Messrs. Arrol have been on the work it must be admitted that they have shown great energy and skill. Already several girders for the north piers have been delivered, and are being fitted. When this has been done to some extent, a better opportunity will be afforded of contrasting the new with the old bridge. The verdict is certain to be in favour of the new, for in all respects it presents features of substantiality which were not to be found in the old. While it is impossible as yet to say when the Messrs. Arrol will complete their contract, the travelling public will be glad to learn that so much as already been accomplished. When all the pontoons have been brought into requisition, there should be very little delay with the foundations, which are really the most troublesome part of the work. At the half-yearly meeting of the North British Railway Company, at Edinburgh, the other day, Sir James Falshaw, the chairman, stated that the contractors had informed him that the bridge would be erected by the end of the summer of 1885.

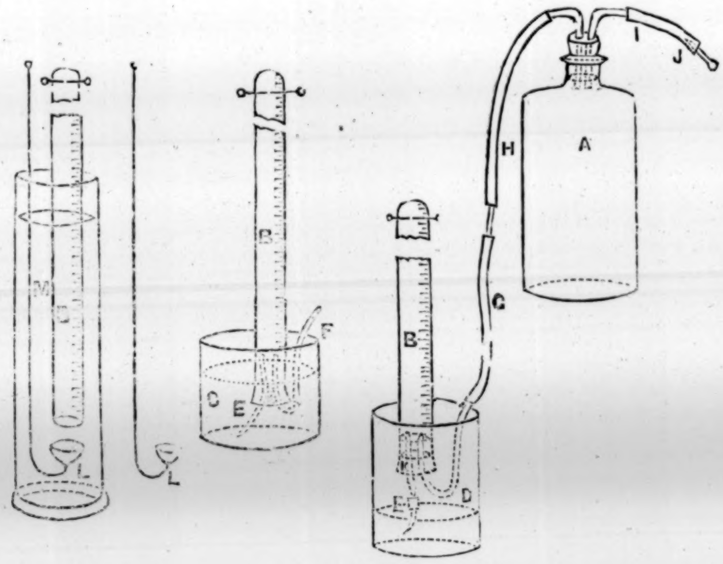
Bagasse Furnace.—This is a furnace recently patented in which green bagasse may be burned as a fuel in the manufacture of sugar and molasses in the localities where fuel is scarce and expensive. The invention consists of a chute or chutes contrived, in connection with the furnace, for feeding the fuel along where it is exposed to the heat of the furnace or the flue leading therefrom to the chimney a suitable distance, and for a length of time enabling the fuel to dry and heat, so that it will burn with good results when it finally discharges into the furnace. In evaporating and other furnaces the inventor proposes to arrange the chute to enter the furnace from the back, where the fuel will have the benefit of the whole length of the run of the flame under the evaporating pans from the furnace to the chimney. This invention has been patented by Mr. John Hill.

Stirrup for Riding Saddles—The improvement consists in a toe guard and tilting arranged to ensure a certain and ready escape of the feet of the rider, in case of accident, so that should the rider be thrown from the horse he will not be dragged by the stirrup. In this stirrup a thin strip of metal is connected with the top of the yoke at the back, and extends to the front of the bottom plate, where it is secured. The foot plate is pivoted to the rear of the bottom plate, and is capable of tilting with the foot, while the thin metal strip above mentioned prevents the toe from catching in the yoke. A novel spur is attached to this stirrup. It consists of a sliding rod carrying a rounded and perforated button, behind which are the spurs, which cannot touch the horse unless the button is pushed back by pressure of the stirrup against the sides of the horse. When pressure is exerted on the bottom the spurs are protruded, and the horse is pricked more or less according to the amount of pressure applied. This invention has been patented by Mr. Philip Ganzhorn, of Washington, Ill.

ON AN APPARATUS FOR RAPID ANALYSIS OF GASES.

By A. A. Breneman, S.B.

The apparatus here described is designed for rapid analysis of gaseous mixtures where only a moderate degree of accuracy is required. It is possible nevertheless to secure very good results with it, if it be carefully handled, and if its known source of error be guarded against. As an example of the results that may be obtained with it, two analyses of air may be quoted which yielded respectively 21·04 per cent and 21·13 per cent by volume of oxygen instead of 20·96 per cent, which is probably a fair average for the most accurate analyses. The oxygen was absorbed by a solution of pyrogallic acid in caustic potash, in the proportion of 2 grms. of the solid acid to 5 c.c. of a solution of KHO (sticks) in twice its weight of water, and 10 c.c. of water were further added to the solution. The absorption of oxygen in each case occupied about twelve minutes. The excess of oxygen indicated is probably to be accounted for by the solution of part of the gaseous mixture in the water used for rinsing, but the error belongs to all absorption-methods of analysis where the gas is measured over water.



The apparatus and its use will be readily understood from the accompanying diagram. A is a bottle holding a litre or more. It is closed by a soft rubber stopper carrying two tubes, one of which communicates with a water air-pump, the other with the gas burette. After exhausting the bottle at the pump, the tube I is closed by the stopper; F G H is already closed by a bit of stirring rod, plugging the rubber tube G at F, and serving also as a valve. It is opened by simply pinching up a portion of the rubber tube about it, thus forming a channel around the plug. The gas burette B is closed by a rubber stopper K, carrying two tubes, one of which connects with A; the other carries a valve at E and a pointed tube of glass at its end.

The gas burette is filled with gas over the pneumatic trough C, the cork K being removed. It is then transferred by means of the deep spoon L to the measuring cylinder, the volume of the gas is noted with the existing temperature, the burette is again brought to the trough, K is inserted, and then by opening the valve F the level of water in the burette is brought to the inner surface of the cork K, the water passing into the exhaust bottle L. This bottle is used in the same way subsequently to receive all drainings and rinsing water from the burrette.

The absorption liquids are introduced by bringing the point of the tube below E into the liquid and opening E; liquid rushes into the partially exhausted tube to replace the water previously withdrawn.

The burette is shaken to distribute the liquid over its sides, and more of the liquid is introduced as the absorption proceeds. When absorption is complete the liquid is withdrawn as before, the tube is rinsed with successive small quantities of water, and the gas finally measured again over water in the cylinder M.

The obvious errors of the apparatus are the entrance of air about the cork K, and separation of gases from the liquids used in the burette when the level of the liquid in the latter is reduced. A soft, well-fitting rubber stopper will remove the first objection, and as an additional precaution the mouth of the burette is kept below the surface of the water whenever it is not necessary to manipulate the burette. In practice the entrance of external air through leakage is inappreciable during the time of the analysis.

The second source of error is avoided by using such quantities of absorbing liquids that the diminution of pressure within the burette may be slight. During the time of greatest exhaustion, that is, during the withdrawal of liquids, the current tends to carry minute bubbles that may separate downwards and into the bottle, and with a good vacuum (20·25 inches of mercury) in the latter, the time is too short to permit of any important volume of gas separating from the liquid.—*Journ. Am. Chem. Soc.*

THE CENTRAL STATION EDISON DYNAMO MACHINE.

Now that central stations for the lighting of districts are about to be erected in several parts of London, the subject of generators capable of giving powerful currents acquires a new interest, and at the same time the problem of driving them presses for solution. Hitherto a large installation has been little more than an assemblage within one building of several small ones driven from one or two countershafts, and thus it has come that such plants have presented an appearance of complication, and have further, from the creaking and rustling of the belts, given the idea that an immense amount of wear and tear was going on. It is quite certain that before large areas, employing many thousands of lights, can be supplied from one source, great alterations both in the sizes of the generators themselves, and in the means of transmission, will have to be made before practical success is attained. The earliest and most enthusiastic advocate of district lighting was Mr. Edison, and although his anticipations have not been realised with the rapidity he predicted, yet his system is spreading rapidly in the States, where the company engaged in carrying it out has obtained greater experience of town lighting than any other firm in this country. Consequently their operations acquire additional interest to English electricians who are about to engage in enterprises of a magnitude far beyond their previous experiences. The latest type of the Edison dynamo machine appears to be designed for feeding 1,200 incandescence lamps from a central station. The generator is driven directly from the engine without the use of belts or gearing, and consequently revolves at a moderate speed, about 350 revolutions per minute, while there is no fear of a stoppage from the failure of the intermediate parts. The engine is of the Porter-Allen type, and indicates about 200 horse-power; it is fitted with a Porter governor and an automatic expansion gear, and drives on to a crank-pin fitted between two balance discs. The dynamo follows the ordinary horizontal Edison type, the armature being formed of copper bars upon a core built up of alternate discs of sheet iron and paper, and the field magnets, of which there are twelve, being placed in a shunt circuit. A small fan delivers a constant stream of air on the centre of the armature, where it divides and flows to each end, carrying away the heat generated by the current. Five brushes, each in a separate holder, press upon each side of the commutator, and deliver the current into the two mains, from whence it is distributed through the network of conductors laid all over the district. The point of contact between the brushes and the commutators can be varied, as the whole system is carried on a pivot co-axial with the armature. Mr. Edison's system provides for the connexion of several such machines with one set of mains, and for their regulation according to the demands made upon them.

Effects of Brain Disturbance on the Handwriting.—Dr. Stone, at the British Association, read a paper on the above subject. It was not surprising, he said, that affections of the cerebral hemispheres competent to interfere with the complex co-ordination of speech should also show their influence on the similar act of writing. Essentially both functions were acquirements which by practice had become automatic, and were put forth involuntarily. He said, therefore, that as the defect known as aphasia might occur in different parts of the circuit, so might graphic modifications. Three such cases he described, one of which occurred to himself personally. After sustained mental effort, he fell down in a partial state of insensibility. During three weeks delirium and delusions predominated over physical depression. These were broken, however, by lucid intervals. The leading feature of all his aberrations seemed to have been reduplication. He doubted the number of sisters, his nurses, and his medical attendents. When he returned to himself and could trust his memory and senses he found two things—first, what he had been accustomed to call aphasia; secondly, that he could not write as he intended. The tendency to reduplication, which was obvious in his delusions, was as clear as need be in his writing, and the trick of including otiose letters in familiar words lasted for some time. It was probably the trace either of mental stammering or of dialographia, depending upon want of synchronism between the two hemispheres of the brain. That such a condition of the ocular muscles occurred in drunkenness was well known.

THE AMERICAN PATENT OFFICE REPORT FOR 1883.

The Commissioner of Patents has submitted his report for the fiscal year ended June 30, 1883. It shows the following facts:

Applications.

For patents	32,845
For design patents	1,039
For reissue patents	247
For registration of trade marks	854
For registration of labels	749
Total	35,734
Total in 1882	30,062
Caveats filed	2,688

Patents and Trade Marks Issued.

Patents granted, including re-issues and designs	21,185
Trade marks registered	883
Labels registered	618
Total	22,686
Patents withheld for non-payment of final fees	2,056
Patents expired	7,471

Receipts and Expenses.

	Dollars.
Receipts from all sources	1,095,884
Expenditures (not including printing)	677,628
Surplus	518,255
Increase in receipts over 1881	305,989
Increase over 1882	165,020

The number of applications awaiting action on the part of the office on July 1 was 4,699, an increase of 39 per cent over 1882. The Commissioner says the business of the office is steadily and rapidly increasing in each of the divisions of the office. The success of the patent system, the Commissioner says, is due largely to its liberality to inventors, and the security and protection it affords them. It was not intended that revenue to the Government should be obtained by charges made for vesting in the inventor the right and title for a limited time to the exclusive use of his invention. But not only have the fees received on applications filed been sufficient to pay all the expenses of the office, but a large surplus—nearly 2,500,000—now stands to the credit of the office in the Treasury. Greater liberality might, perhaps, be extended to the inventor by reducing the fee to be paid before a patent can issue, and with beneficial results. Certainly a more equitable rate of fees could be adopted than is now provided by graduating the fee to the character and nature of the invention. The fees now required in some cases are excessive, and in others exceedingly small. In this way, rather than by an indiscriminate reduction in the fees now charged, as is urged by some, justice would be secured, and the office still be self-supporting.

Commissioner Marble comments with some severity upon the action of Congress in refusing the additional clerical force required, and in reducing the number of overworked employes. He says: "I have learned with great satisfaction that inventors and manufacturers throughout the country will soon take steps to impress upon those who have hitherto treated their rights with some indifference the importance of having a sufficient force in this bureau—as well as other appliances and accommodations—to fairly and promptly act upon their applications and determine their rights to the inventions claimed by them. It is believed by most of them that their votes are of quite as much importance and their support to the Government fully as necessary as pensioners and settlers upon the public lands, to whom not too great liberality has been shown.

Attention is called to the fact that a large number of examiners and assistant examiners have resigned during the last year. The Commissioner assigns as the principal reason for the resignations the insufficiency of the salaries allowed, and says the office feels the loss of such experienced men more than any other bureau. He adds: "The same reasons, substantially, which require an increase in the force of the offices in order that the work may be promptly and efficiently done, exist for urging proper salaries for securing the most efficient men for doing this class of work." The report recommends that Congress confer upon the Commissioner authority to institute proceedings to determine the question of the public use or sale of an invention. The attention of Congress is again called to the necessity for amending the statutes relating to the issue of foreign patents, either by granting the patent for a definite term, where the invention has first been patented in a foreign country or countries without any conditions subsequent, or by granting it for the full term of seventeen years from the date of the earliest foreign patent.

IMPROVED PHOTO-ENGRAVING PROCESS BY CAPT. BINY.

1. Take some highly polished zinc, thickness No. 8 or No. 10; choose the smoothest sheets, free from streaks and defects.

2. Clean the plate in the water containing three per cent of hydrochloric acid, and get rid of all bubbles of hydrogen.

3. Render it hygroscopic in the bath of iodine, gallic acid, and phosphoric acid, indicated in a previous description of the process of photo-engraving in outline.

4. Next wash the zinc in running water, and dry carefully between blotting paper.

5. When quite dry, coat it with coal tar pitch, eight per cent dissolved in pure benzine; as soon as spread, it may be heated in the dark up to the temperature of 50° C., and allowed to dry until, upon cooling, it is no longer sticky.

6. Expose behind a positive plate having soft half tints.

7. Control the exposure with the help of slips coated with coal tar; it is more rapid than bitumen.

8. Develop as before with turpentine and benzine, and finish the process in petroleum and one-tenth its quantity of spirits of turpentine. This new bath by forming a light homogeneous varnish gives a chemical grain well suited to the half tints of the tar. Next cause the plate to rotate so that the mixture of the petroleum and turpentine may be uniform in texture and almost entirely evaporated. Heat the plate again up to 50° or 60° C., and allow it to cool.

9. To engrave the image thus obtained on the zinc with all its half tints, make use of the following bath:—

Pure water	100	grammes.
Water saturated with sulphate of copper	50	„
Sulphuric or hydrochloric acid	3	„

Bubbles of hydrogen will be disengaged from all the little points constituting the chemical grain of the plate, and at the same time particles of copper will be deposited in their place, forming a positive image, which must not be touched while in the bath. As soon as the image is well formed in copper, it can be removed and placed in water, frequently changed. It may next be wiped between blotting paper, and dried in the open air.

10. Remove the insoluble coal tar and non-adherent copper with a brush soaked in benzine. Rinse with clean benzine, and wipe well with a soft cloth so as not to scratch it.

11. To ink the plate, coat it with varnish or oil and fatty ink, so as to fill up the grain of the picture—heating it if necessary.

12. Rub the plate with a damp flannel to remove superfluous ink, and print off in a press for line engraving if the lines are deep, or in a lithographic press if but slightly indented. The depth of the lines in the plate depends on the thickness of the coal tar film. This process is most ingenious, and the various operations it admits of are more easy to execute than describe.

THE EFFECT OF OIL IN CALMING WAVES IN A STORM.

Mr. E. P. Culverwell, at the British Association, read a paper on the above subject: He said when the surface of the sea had become smooth after a storm it was very common for long rollers to break on a sand-bar. If there were no wind and the sea was glassy these would not break until quite close to the shore shore, even though the ordinary theory pointed to the breaking earlier, unless there was a force directed opposite to that of their motion. When exerted on the waves such a force might be supplied by the wind: but if it rose in any direction the waves broke much sooner. This result was, therefore, due to some secondary effect produced by the wind pressure, and not directly by the pressure itself, and it was to the ripples produced on the surface, which disturbed the wave motion, that the speedy breaking was to be attributed. It was, however, a direct result of the theory that the ripples depended on surface tension for their propagation, and could not exist in large amount on the oiled surface. It was also evident that the hold of the wind on the was greatly decreased by the absence of ripples, and thus the oil acted both to prevent the wind having much effect on the surface, and also to modify the motion of the water in the wave.

Paper Gas Pipes.—These are made by passing an endless strip of hemp paper, the width of which equals the length of the tube, through a bath of melted asphalte, and then rolling it tightly and smoothly on a core, to give the required diameter. When the number of layers thus rolled is sufficient to afford the desired thickness, the tube is strongly compressed, the outside sprinkled with fine sand, and the whole cooled in water. When cold the core is drawn out, and the inside served with a waterproofing composition. In addition to being absolutely tight and smooth, and much cheaper than iron, these pipes have great strength; for when the sides are scarcely three-fifths of an inch thick they will withstand a pressure of more than fifteen atmospheres. If buried underground they will not be broken by settlement, nor violently shaken or jarred. The material being a bad conductor of heat, the pipes do not readily freeze.

A New Pass Through the Andes.—The recent discovery of a pass, hidden for centuries, in the mountains between Chili and Argentine Republic, near Lake Nahuelhaspi, may have a powerful influence upon the development of a region which has been one of the world's neglected corners. By this pass the route from the extreme western outpost of the Argentine Republic, across Chili at its narrowest part, to the Pacific coast, is only seventy miles long, so that a railway can be built directly across the point of South America, from the Gulf of San Matras, through the pampas, to a Chilian port at the head of the gulf, which lies between Chiloe Island and the mainland. A railway is now in process of construction from Buenos Ayres, in a north-westerly direction, by way of Mendoza to Santiago, but the route made available by the Barilochi pass is less than one-half the length of that one. Perhaps this discovery and the explorations of Chilian and Argentine soldiers will open to improvement the region which corresponds in respect to the climate with the United States. We are apt to forget that the greater part of South America lies in the hot zone, and only the southern point, which is owned partly by Chili and partly by the Argentine Republic, lies in the latitude of the New England and Middle States, and the route through the newly discovered pass is in the latitude which corresponds to the latitude of this city. Vast plains there await development.

The Scientific Review

AND

SCIENTIFIC AND LITERARY REVIEW,

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SESSION 1882—1883.

If any meeting be held special notice *per post* will be supplied.

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Proceedings of the Institute.

The Institute being out of session no meetings have been held.

Monthly Notices.

Philadelphia Electrical Exhibition.—An International Electrical Exhibition, under the auspices of the Franklin Institute, will be opened at Philadelphia on Tuesday, September 2nd, 1884. An Act has been passed by Congress, which provides for the admission into the United States, duty free, of all articles for exhibition only.

Vegetable Wool.—The *Moniteur des fils et tissus* calls attention to a description of vegetable wool called *Kapoc*. It comes from Java, and a specimen is on view at the Amsterdam Exhibition. It arrives at Amsterdam in its leathery covering, being itself enveloped in the seeds. It is then freed from both, and is carded so as to make a very light mattress wool, worth about 8¾d. per pound. One of the houses engaged in this operation had made trials in spinning and dyeing this material, but the filaments are said to be like strings, and their industrial application consequently a matter of uncertainty.

Syrian Silk.—The *Central Blatt fur Textil Industrie* gives some details as to a vegetable substance somewhat resembling silk, to which attention has lately been drawn by its having been exhibited in Greece. It is stated that this substance is a silky-haired portion of a tree-like shrub which comes originally from America, but is found in Syria and the South of Europe (*Asclepias Syriæ*), of the family of the Asclepiades. It is also known as the Syrian silk-plant. The substance in question is used for stuffing very soft cushions, when mixed with silk and wool. This Syrian silk is used in different tissues. The milky juice of the plant is said to be poisonous, and the tough stalks can be used in the same manner as the corresponding portions of the hemp plant.

Nice International Exhibition.—This Exhibition of Agriculture, Industry, and the Fine Arts, is under the patronage of the French Government, the Nice Municipality, the General Council of the Department of Alpes Maritimes, and the Nice Chamber of Commerce. The following are the principal regulations. The Exhibition will be open from 1st December, 1813, to 1st May, 1884. No goods will be admitted after the end of October. The Exhibition building will constitute a bonded warehouse. All French railways and steamboat companies grant a reduction of 50 per cent on the carriage of goods for exhibition. Every exhibitor must have a representative at Nice. No charge will be made for space in the fine art department; but in the others, the charge will be from 25 frs. to 50 frs. per square metre for ground space; and 15 frs. to 25 frs. for wall space in the main building; 10 frs. to 20 frs. for ground and wall space in the annexes; and 5 frs. to 10 in the open air. No goods may be removed before the close of the Exhibition. Motive power will be supplied gratuitously in the machinery annexe and the *Galerie du Travail* (department of processes shown in practical work); but steam, water, gas, or electricity must be paid for according to consumption.

Ensilage.—Mr. T. H. Miller, of Singleton Park, near Preston, has lately made an experiment to see whether it is necessary for a "silo" to be a pit or excavation. He made use of an old cart-house, above which was a granary, the flooring of which he had cut away, with the exception of a portion at one end to serve as a platform. The walls of the building were lined with cement to the height of eight feet, and when this was set the filling of the silo began. Between the 25th of June and the end of August there were placed in it, at irregular intervals, 15 tons of meadow grass in a wet condition, 15 tons 4 cwts. of rye grass and clover, and 4 tons 15 cwts. of green oats in full head, chopped into 3-in. lengths; total, 34 tons 19 cwts., the produce of seven acres. The mass was kept covered with clotted boards, and weighted with 200 bags containing 126 lbs. of sand each. These were manipulated easily by means of a rope and pulley, worked from the platform. On the 27th August there was no heat or brewing, and but the very slightest perceptible warmth. A portion of the ensilage, taken from the depth of 37 inches, was of a yellowish brown, and moist, but perfectly sweet. A bullock ate some of it greedily, and a handful put in some hay was eaten by a cow before she would touch the hay. The silo is to be formally open in November, in the presence of a number of farmers and friends.

THE SCIENTIFIC REVIEW

AND

Scientific and Literary Review

INCORPORATING THE "JOURNAL OF THE INVENTORS' INSTITUTE."

OCTOBER, 1883.

THE BRITISH ASSOCIATION.

THE 1883 meeting of this Association was opened at Southport, on Wednesday, September 19th.

The vacancies in the Council were filled up at the General Committee by the appointment of Sir F. J. Bramwell, Professor Dewar, Lieut. Godwin Austen, Professor Henrici, and Mr. Sclater Booth. The new trustees in place of the late Sir Edward Sabine and Mr. Spottiswoode, are Lord Rayleigh and Sir Lyon Playfair. Mr. A. G. Vernon Harcourt is appointed one of the general secretaries.

The new President, Professor Cayley, received a hearty welcome at the evening meeting, where he was supported by most of the distinguished men of science. He was introduced to them in the usual form at such meetings by the retiring President, Sir W. Siemens, who, in a felicitous address, recalled the principal achievements of Professor Cayley, and presented him to them as one of the greatest of living mathematicians. Professor Cayley, on taking the chair and stepping forward to deliver his presidential address, was loudly cheered.

It is the custom of the Presidents of the Association to commence their addresses with a tribute to the memory of those who have died during the year. This year Professor Cayley had to refer to the loss of three prominent members who have died since the Southampton meeting. Professor Henry Smith he lamented as an ardent and successful mathematician, and credited with important works, some of which are being posthumously published, on the Theory of Numbers. The late General Sir E. Sabine's long connection with the Association and active life was recalled in a few sentences of striking comprehensiveness. Of the third great loss—that of the late President of the Royal Society—his words were few but impressive, and their reception was indicative of the general sorrow that the place of Mr. Spottiswoode would know him no more.

The event of the year to the President, recorded in the forefront of his address was "the determination by Mr. James Glaisher of the least factors of the missing three out of the first nine million numbers." That fact announced among his preliminary observations, the President called attention to mathematics as connecting themselves on the one side with common life and the physical sciences, and on the other side with philosophy in regard to our notions of space and time and the questions which have arisen as to the universality and necessity of the truths of mathematics and the foundation of our knowledge of them. For some little time he interested the audience in a discussion of the position maintained by John Stuart Mill that the truths of mathematics and particularly those of geometry rest on experience. By quotations from Mill he recalled that philosopher's opinion that you can only maintain the character of mathematics for being systems of necessary truth, independent of the evidence of experience and observation, by resorting to the supposition that the truths of mathematics relate to and express the properties of purely imaginary objects. He quoted Mill's opinion that the points, lines, and squares any one has in his mind are simply copies of points, lines, and squares known in his experience; that though for instance we may reason about a line as if it had no breadth, we can form no mental picture of such a line, all the lines we have in our mind being lines possessing breadth. The President stated that the general opinion was still opposed to the conclusions of Mill. The general opinion now is that while it is indeed by experience that we arrive at the truths of mathematics, this experience is not their proper foundation. The mind itself contributes something. This view was stated in the world-famed saying of Leibnitz, who followed up the admission that there was nothing in the intellect which was not first in sensation with the very important qualification, "except the intellect itself." It was repeated in Kant's view that while all cognition began with experience we were nevertheless in possession of cognitions à priori. Finally, for contrast with Mill's opinion, Sir W. R. Hamilton's opinion was quoted in these words:—"These purely mathematical sciences of algebra and geometry are sciences of the pure reason, deriving no weight and no assistance from experiment, and isolated or at least isolable from all outward and accidental phenomena. The idea of order, with its subordinate ideas of number and figure, we must not indeed call innate ideas, if that phrase be defined to imply that all men must possess them with equal clearness and fulness: they are, however, ideas which seem to be so far born with us that the possession of them in any conceivable degree is only the development of our original powers, the unfolding of our proper humanity."

These being the views placed by the President in contrast, the following are a few of his observations upon Mill's theory:—

I think it may be at once conceded that the truths of geometry are truths precisely because they relate to and express the properties of what Mill calls "purely imaginary objects," that these objects do not exist in Mill's sense, that they do not exist in nature, may also be granted; that they are "not even possible," if this means not possible in an existing nature, may also be granted. That we cannot "conceive" them depends on the meaning which we attach to the word conceive. I would myself say that the purely imaginary objects are the only realities, the ὄγτων ὄγτα in regard to which the corresponding physical objects are as the shadows in the cave; and it is only by means of them that we are able to deny the existence of a corresponding physical object; if there is no conception of straightness, then it is meaningless to deny the existence of a perfectly straight line. But at any rate the objects of geometrical truth are the so-called imaginary objects of Mill, and the truths of geometry are only true, and *a fortiori* are only necessarily true, in regard to these so-called imaginary objects: and these objects, points, lines, circles, &c., in the mathematical sense of the terms, have a likeness to and are represented more or less imperfectly, and from a geometer's point of view no matter how imperfectly, by corresponding physical points, lines, circles, &c. Whatever difficulty be raisable as to geometry, it seems to me that no similar difficulty applies to arithmetic; mathematicians or not we have each of us, in its most abstract form, the idea of a number; we can each of us appreciate the truth of a proposition in regard to numbers; and we cannot but see that a truth in regard to numbers is something different in kind from an experimental truth generalised from experience. Compare, for instance, the proposition that the sun, having already risen so many times, will rise to-morrow, and the next day, and the day after that, and so on; and the proposition that even and odd numbers succeed each other alternately *ad infinitum*; and the latter at least seems to have the characters of universality and necessity. Or again, suppose a proposition observed to hold good for a long series of numbers, one thousand numbers, two thousand numbers as the case may be; this is not only no proof, but it is absolutely no evidence, that the proposition is a true proposition, holding good for all numbers whatever; there are in the theory of numbers very remarkable instances of propositions observed to hold good for very long series of numbers and which are nevertheless untrue.

The President then passed in review certain mathematical theories having a bearing on the philosophical question, and in the course of these expressed an opinion that the philosophers ought to turn their attention to, and subject to inquiry and discussion, a fundamental notion pervading the whole of modern analysis and geometry—the notion of imaginary magnitude and space.

The following is the portion of the presidential address regarding the connection between mathematics and physical science:—

I said that I would speak to you, not of the utility of mathematics in any of the questions of common life or of physical science, but rather of the obligations of mathematics to these different subjects. The consideration which thus presents itself is in a great measure that of the history of the development of the different branches of mathematical science in connection with the older physical sciences, astronomy and mechanics; the mathematical theory is in the first instance suggested by some question of common life or of physical science, is pursued and studied quite independently thereof, and perhaps after a long interval comes in contact with it, or with quite a different question. Geometry and algebra must, I think, be considered as each of them originating in connection with objects or questions of common life—geometry, notwithstanding its name, hardly in the measurement of land, but rather from the contemplation of such forms as the straight line, the circle, the ball, the top (or sugar-loaf): the Greek geometers appropriated for the geometrical forms corresponding to the last two of these, the words σφυῖρα and κῶνος our cone and sphere, and they extended the word cone to mean the complete figure obtained by producing the straight lines of the surface both ways indefinitely. And so algebra would seem to have arisen from the sort of easy puzzles in regard to numbers which may be made, either in the picturesque forms of the Bija-Ganita with its maiden with the beautiful locks, and its swarms of bees amid the fragrant blossoms, and the one queen-bee left humming around the lotus flower; or in the more prosaic form in which a student has presented to him in a modern text book, a problem leading to a simple equation. The Greek geometry may be regarded as beginning with Plato (B.C. 430-347); the notions of geometrical analysis, loci, and the conic sections are attributed to him, and there are in his dialogues many very interesting allusions to mathematical questions; In particular the passage in the "Theætetus," where he affirms the incommeasurability of the sides of certain squares. But the earliest extant writings are those of Euclid (B.C. 285); there is hardly anything in mathematics more beautiful than his wondrous fifth book; and he has also in the seventh, eighth, ninth, and tenth books fully and ably developed the first principles of the theory of numbers, including the theory of incommeasurables. We have next Apollonius (about B.C. 247), and Archimedes (B.C. 287-212), both geometers of the highest merit, and the latter of them the founder of the science of statics (including therein hydrostatics); his dictum about the lever, his "Εὕρηκα," and the story of the defence of Syracuse are well known. Following these we have a worthy series of names, including the astronomers Hipparchus (B.C 150) and Ptolemy (A.D. 125)), and ending, say, with Pappus (A.D. 400), but continued by their Arabian commentators and the Italian and other European geometers of the sixteenth century and later, who pursued the Greek geometry. The Greek arithmetic was, from want of a proper notation, singularly cumbrous and difficult, and it was for astronomical purposes superseded by the sexagesimal arithmetic, attributed to Ptolemy, but probably known before his time, The use of the present so-called Arabic figures became general among Arabian writers on arithmetic and astronomy about the middle of the tenth century, but was not introduced into Europe until about two centuries later. Algebra among the Greeks is represented almost exclusively by the treatise of Diophantus (A.D. 150), in fact a work on the Theory of Numbers containing questions relating to square and cube numbers, and other properties of numbers, with their solutions; this has no historical connection with the later algebra, introduced into Italy from the East by Leonardi Bonacci of Pisa (A.D. 1202-1208) and successfully cultivated in the fifteenth and sixteenth centuries by Lucas Paciolus, or De Burgo, Tartaglia, Cardan, and Ferrari. Later on, we have Vieta (1540-1603), Harriot, already referred to, Wallis, and others. Astronomy is of course intimately connected with geometry. The most simple facts of observation of the heavenly bodies can only be stated in geometrical language, for instance, that the stars describe circles about the pole star, or that the different positions of the sun among the fixed stars in the course of the year form a circle. For astronomical calculations it was found necessary to determine the arc of a circle by means of its chord. The notion is as old as Hipparchus, a work of whom is referred to as consisting of twelve books on the chords of circular arcs; we have (A.D. 125) Ptolemy's "Almagest," the first book of which contains a table of arcs and chords with the method of construction, and among other theorems on the subject he gives there the theorem afterwards inserted in Euclid (Book VI. Prop. D) relating to the rectangle contained by the diagonals of a quadrilateral inscribed in a circle. The Arabians made the improvement of using in place of the chord of an arc the sine, or half chord of double the arc; and so brought the theory into the form in which it is used in modern trigonometry: the before-mentioned theorem of Ptolemy, or rather a particular case of it, translated into the notation of sines, gives the expression for the sine of the sum of two arcs in terms of the sines and cosines of the component arcs; and it is thus the fundamental theorem on the subject. We have in the fifteenth and sixteenth centures a series of mathematicians who with wonderful enthusiasm and perseverance calculated tables of the trigonometrical or circular functions, Purbach, Muller, or Regiomontanus, Copernicus, Reinhold, Maurolycus, Vieta, and many others; the tabulations of the functions tangent and secant are due to Reinhold and Maurolycus respectively. Logarithms were invented, not exclusively with reference to the calculation of trigonometrical tables, but in order to facilitate numerical calculations generally; the invention is due to John Napier, of Merchiston, who died in 1618 at 67 years of age; the notion was based upon refined mathematical reasoning on the comparison of the spaces described by two points, the one moving with a uniform velocity, the other with a velocity varying according to a given law. It is to be observed that Napier's logarithms were nearly but not exactly those which are now called (sometimes Napierian, but more usually) hyperbolic logarithms—those to the base e; and that the change to the base 10 (the great step by which the invention was perfected for the object in view) was indicated by Napier, but actually made by Henry Briggs, afterwards Savilian Professor at Oxford (d. 1630). But it is the hyperbolic logarithm which is mathematically important. The direct function ex or exp. x, which has for its inverse the hyperbolic logarithm, presented itself, but not in a prominent way. Tables were calculated of the logarithms of numbers, and of those of the trigonometrical functions. The circular functions and the logarithm were thus invented each for a practical purpose, separately and without any proper connection with each other. The functions are connected through the theory of imaginaries and form together a group of the utmost importance throughout mathematics; but this is mathematical theory; the obligation of mathematics is for the discovery of the functions. Forms of spirals presented themselves in Greek architecture, and the curves were considered mathematically by Archimedes. The Greek geometers invented some other curves, more or less interesting, but recondite enough in their origin. A curve which might have presented itself to anybody, that described by a point in the circumference of a rolling carriage-wheel, was first noticed by Mersenne in 1615, and is the curve afterwards considered by Roberval, Pascal, and others under the name of the Roulette, otherwise the Cycloid. Pascal (1623-1662) wrote at the age of seventeen his "Essais pour les Coniques" in seven short pages, full of new views on these curves, and in which he gives, in a paragraph of eight lines, his theorem of the inscribed hexagon. Kepler (1571-1630) by his empirical determination of the laws of planetary motion, brought into connection with astronomy one of the forms of conic, the ellipse, and established a foundation for the theory of gravitation. Contemporary with him for most of his life, we have Galileo (1564-1642), the founder of the science of dynamics; and closely following upon Galileo we have Isaac Newton (1643-1727); the "Philosophiæ naturalis Principia Mathematica," known as the "Principia," was first published in 1687. The physical, statical, or dynamical questions which presented themselves before the publication of the "Principia" were of no particular mathematical difficulty, but it is quite otherwise with the crowd of interesting questions arising out of the theory of gravitation, and which, in becoming the subject of mathematical investigation, have contributed very much to the advance of mathematics. We have the problem of two bodies, or what is the same thing, that of the motion of a particle about a fixed centre of force, for any law of force; we have also the (mathematically very interesting) problem of the motion of a body attracted to two or more fixed centres of force; then, next preceding that of the actual solar system—the problem of three bodies; this has ever been and is far beyond the power of mathematics, and it is in the lunar and planetary theories replaced by what is mathematically a different problem, that of the motion of a body under the action of a principal central force and a disturbing force; or (in one mode of treatment) by the problem of disturbed elliptic motion. I would remark that we have here an instance in which an astronomical fact, the observed slow variation of the orbit of a planet, has directly suggested a mathematical method, applied to other dynamical problems, and which is the basis of very extensive modern investigations in regard to systems of differential equations. Again, immediately arising out of the theory of gravitation, we have the problem of finding the attractionof a solid body of any given form upon a particle, solved by Newton in the case of a homogeneous sphere, but which is far more difficult in the next succeeding cases of the spheroid of revolution (very ably treated by Maclaurin) and of the ellipsoid of three unequal axes. There is perhaps no problem of mathematics which has been treated by as great a variety of methods, or has given rise to so much interesting investigation as this last problem of the attraction of the ellipsoid upon an interior or exterior point. It was a dynamical problem, that of vibrating strings, by which Lagrange was led to the theory of the representation of a function as the sum of a series of multiple sines and cosines; and connected with this we have the expansions in terms of Legendre's functions P_n, suggested to him by the question just referred to of the attraction of an ellipsoid; the subsequent investigations of Laplace on the attractions of bodies differing slightly from the sphere led to the functions of two variables called Laplace's functions. I have been speaking of ellipsoids, but the general theory is that of attractions, which has become a very wide branch of modern mathematics; associated with it we have in particular the names of Gauss, Lejeune-Dirichlet, and Green, and I must not omit to mention that the theory is now one relating to n-dimensional space. Another great problem of celestial mechanics, that of the motion of the earth about its centre of gravity, in the most simple case, that of a body not acted upon by any forces, is a very interesting one in the mathematical point of view. I may mention a few other instances where a practical or physical question has connected itself with the development of mathematical theory. I have spoken of two map projections — the stereographic dating from Ptolemy, and Mercator's projection, invented by Edward Wright about the year 1600; each of these, as a particular case of the orthomorphic projection, belongs to the theory of the geometrical representation of an imaginary variable. I have spoken also of perspective, and of the representation of solid figures employed in Monge's descriptive geometry. Monge, it is well known, is the author of the geometrical theory of the curvature of surfaces and of curves of curvature: he was led to this theory by a problem of earthwork; from a given area, covered with earth of uniform thickness, to carry the earth and distribute it over an equal given area, with the least amount of cartage. For the solution of the corresponding problem in solid geometry he had to consider the interesting normals of a surface, and so arrived at the curves of curvature. (See his "Mémoire sur les Déblais et les Remblais," Memde l'Acad., 1781.) The normals of a surface are, again, a particular case of a doubly infinite system of lines and are so connected with the modern theories of congruences and complexes. The undulatory theory of light led to Fresnel's wave-surface, a surface of the fourth order, by far the most interesting one which had then presented itself. A geometrical property of this surface, that of having tangent planes each touching it along a plane curve (in fact, a circle), gave to Sir W. R. Hamilton the theory of conical refraction. The wave-surface is now regarded in geometry as a particular case of Kummer's quartic surface, with sixteen conical points and sixteen singular tangent planes. My imperfect acquaintance as well with the mathematics as the physics prevents me from speaking of the benefits which the theory of Partial Differential Equations has received from the hydrodynamical theory of vortex motion, and from the great physical theories of heat, electricity, magnetism, and energy. It is difficult to give an idea of the vast extent of modern mathematics. This word "extent" is not the right one: I mean extent crowded with beautiful detail—not an extent of mere uniformity such as an objectless plain, but of a tract of beautiful country seen at first in the distance, but which will bear to be rambled through and studied in every detail of hillside and valley, stream, rock, wood, and flower. But, as for anything else, so for a mathematical theory—beauty can be perceived, but not explained. In conclusion I would say that mathematics have steadily advanced from the time of the Greek geometers. Nothing is lost or wasted; the achievements of Euclid, Archimedes, and Apollonius are as admirable now as they were in their own days. Descartes' method of coordinates is a possession for ever. But mathematics have never been cultivated more zealously and diligently, or with greater success, than in this country—in the last half of it, or at the present time; the advances made have been enormous, the actual field is boundless, the future full of hope. In regard to pure mathematics we may most confidently say:—

Yet I doubt not through the ages one increasing purpose runs,
And the thoughts of men are widened with the process of the suns.

The vote of thanks to the President for his address was proposed by Sir W. Thomson, and seconded by the Mayor of Southport, who in a short and well-delivered speech bade the Association welcome to Southport. Captain Galton stated the number of members who had joined the meeting; and Professor Cayley having briefly acknowledged the compliment paid him, the inaugural meeting was at an end.

SIR F. BRAMWELL ON TELEPHONES.

Sir F. Bramwell, at the British Association Meeting, said that, looking at the fact that the telephone was now an instrument in daily use, both commercially and socially, it was difficult to believe that it was only six brief years ago that, at the Plymouth meeting of this Association, the telephone was for the first time explained by its talented inventor, Mr. Graham Bell, assisted by Mr. W. H. Preece, the electrician to the Post Office, and thus, although the telephone had now become an instrument of every day use, it was probably one of the newest instances of the application of science for the purposes of man. New, however, as the telephone was, it depended, as indeed all inventions did, upon the application of well-known natural laws. But well known as those laws were, it was necessary to consider some of those which were involved in the construction of the telephone. The first of these which he illustrated by well known experiments was that relating to the generation and transmission of sound. Having fully described the construction and working of the telephones of Professor Graham Bell and Mr. Edison, and also the photophone, Sir Frederick considered some of the uses of the telephone and described the private line of the Exchange system. He then said, there are also other uses of the telephone. You can use it as *The Times* does, to convey intelligence to the compositor, who has a head-dress, hears what is said to him, and straightway composes it upon the composing intrument. It is obvious that there must be many other uses of the telephone, but you can imagine them. The adoption of the telephone has spread much more rapidly in America than it has here. For example, Washington has a population of about 120,000 white inhabitants and 60,000 coloured. This population uses 800 telephones. Everything in Washington is done by telephone, and the people do not seem to know how to get on without it. I am glad to say, although we do things very slowly here, the telephone is at last progressing in England. The United Telephone Company, in their circular of the 1st of March last, showed that on the 28th of February, 1881, there were connected to the Exchange in London (I am leaving out all private wires) 845 persons; on the same day in 1882, 1,505, an increase of 660; and on the same day in 1883, 2,541, an increase of 1,036 in the year. I think it is clear that that sort of increase ought to go on in more than arithmetical ratio, because the temptation to subscribe must increase with the increase of your speaking power to a large number of persons. No one would care to join if there were only a dozen to speak to; but when it is found that almost every man has a number in the telephone book, you say, "I had better belong to it, because I can then talk to all these people." Therefore, as the numbers increase, this very increase will tempt others to join. With the increased number of subscribers there comes, as a consequence, and all but inevitably, a greater use of the telephone by each subscriber. It appears that in March last, the average daily calls of each subscriber was 7·59; each call represents two messages, but if you take it as representing only one, you will find, unless my arithmetic has gone wrong, that a payment of £20 a year represents 2d. for each call, or, taking the call and answer, the message each way costs 1d. The number of calls steadily increases, and, as I have said, it is obvious that as the number of subscribers increases the frequency of calls will increase from each subscriber, because he has more persons to talk to. Going to another point, that of the line wire connection, the extreme delicacy of the telephone renders it very liable to disturbance by induced currents. I have spoken hitherto of the telephone as though there were always a complete out and home wire circuit but as a matter of fact the circuit is a wire only one way, and the earth is used the other way. There are certain persons, however, who insist on having an entire metallic circuit. If you use the earth you are liable to a variety of disturbing causes from earth currents, and if you have a powerful dynamo-machine, employing the earth as part of its system, in the neighbourhood you get some very extraordinary results. To show the great delicacy of the telephone, I may mention that when the telephone was first introduced, I was speaking along one, the wire of which was carried on telegraph posts on which there was another wire conveying Morse's signals, and all those Morse signals could be heard in the telephone simply by the induction from one wire to the other. If you have a metallic circuit, and you have the two wires out and home very close together, and if you have them insulated and twist them, you get rid of a great deal of this evil effect, and you do it in an easy intelligible manner. Suppose the effect of induction from a neighbouring wire is to add or to deduct from that which is going on in the telephone wire. Think of it as you would of a pair of scales. If you have a pair of scales, and you put one pound in each scale at the same time, or if you take one pound out of each at the same time, you do not disturb the balance. If, therefore, you have these wires close together and close to the disturbing influence, that influence acts equally on both wires, and it is as though you put one pound in each scale at the same time, or took one pound out at the same time—that is, you do nothing at all. In that way you get rid of the difficulty. I have an apparatus here which, if time permits, will show this. With respect to the distance through which messages can be transmitted telephonically—in March last I was informed from a trustworthy source that 190 miles were being commonly and successfully worked. Since then I have been told—but I do not vouch for it—that as much as 1,000 miles have been experimentally accomplished. I believe that the limit of distance will be found to depend upon the perfection of the insulation and the absence of inductive currents. Common as the telephone now is, let me remind you that if but six short years ago it had been suggested to you that we should within two years of that time be able to reproduce at a distance not merely sounds but articulate speech, and not merely articulate speech, but every trick and accent of the voice of the sender, so that any one listening could say, "That's my friend," or "That is a stranger," or "That is a Scotchman," or "That is an Irishman" who is speaking, would you not have scouted it as the language of an enthusiast? Yet it is but six years ago. In this age the world very soon becomes accustomed to marvels; it does not wonder long—not even the proverbial nine days. I believe if to-morrow you found a man comfortably flying from the top of this building to the end of the pier, and alighting there without injury, it might attract spectators for about a week to see a daily repetition of the flight, and at the end of that time they would pay no more attention to it than if they had been in the habit of seeing men fly ever since they were born.

DRAINAGE BY GRAVITATION AND DISPOSAL OF SEWAGE AT SOUTHPORT.

By Isaac Shone, C.E.

A paper was read on the above subject at the Southport meeting.

I consider myself fortunate in having the opportunity of discussing, in the interests of Southport, the difficulties incidental to drainage of flat sites by gravitation drainage, and the dangers which threaten the health of the inhabitants of such places from inadequate drainage. In Southport we have a health resort naturally possessed of hygienic advantages which justify her in claiming the first place among North of England health-resorts, but she is, by the natural difficulty of draining her site and by the impossibility of draining that site on the present plan of gravitation drainage, in danger of having her natural advantages altogether nullified. It would be too long to discuss the advantages which Southport naturally possesses as a health resort, but I can briefly say that whether we consider the average rainfall and the porous nature of the soil, the careful manner in which the streets are laid out with ample air spaces provided for her population, the result is alike satisfactory. Whilst the fact of the great excess—147 days a year—of south and west winds and her small daily range of temperature, 11·5 degrees, are ascertained facts which tell enormously in her favour. But the fault of the system in use to drain her site as already stated goes far at present to nullify these advantages. I believe that were it not for the constant ventilation of Southport by winds blowing off the sea through her wide streets the evil effects of the present drainage system would utterly ruin her health reputation. I propose to demonstrate that the present drainage system has since its inauguration in 1878 been more or less a source of nuisance, and a danger to the health of the town, and has grievously impaired the reputation of Southport as a health resort. I propose to prove the impossibility of the town being satisfactorily drained by the gravitation system now in operation; and I hope to convince you that by the use of a semi-hydraulic and semi-pneumatic system of drainage, Southport, and all like places situated as she is, may be as satisfactorily drained as if they possessed the most favourable natural advantages for drainage.

In the following I use the date 1878 as a centre for certain comparisons I wish to make. I shall ask you to remember that 1878 is the date of the inauguration of the present system of gravitation drainage. Memorials complaining of sewage smells emanating from its grid ventilators in the streets, and of illness and discomfort attributed to these smells, have been signed by upwards of 2,000 inhabitants in all parts of the town. Also on the occasion of a recent Government Board inquiry held in Southport by Major Tulloch, R.E., for the purpose of authorizing the public authorities to borrow money to extend the present system, that gentleman held it unnecessary to call witnesses to prove that the nuisance was a matter of public notoriety, and was admitted by the Town Council officials of Southport. I, therefore, hold it proven that the present system is a source of danger to the health of the town, because it is an admitted fact that inhalation of sewer gas is the cause of ill health, and it is abundantly proved that sewer gas is more or less always present in the streets of Southport. Many persons attribute illness to the smells from the grid ventilators, either inhaled in the streets or breathed in the very houses to which they have been carried from the sewers. Also the health of Southport has not been, and is not now, what the health of a health resort should be, because its death-rates compare unfavourably: first with the health of places from which persons would naturally come to Southport, in search of health; secondly, because its death-rates give a health standard much below that of other health resorts. With a view to adduce the best possible evidence in support of these allegations I consulted Dr. Wright, of Southport and the following is what he has written me upon the subject:—"Thus, if I compare the average death-rate of fifty large town districts mentioned in the Registrar-General's reports with that of Southport for the term 1879, 1880, 1881, 1882, subsequent to 1878, I find that an average of 19·1 of these towns, with a population of 47,459 as compared with 31,547 for Southport, had an average death-rate of 17·6 as compared with 19·4 for Southport. Now, when I consider that these fifty towns had large mixed populations, with many poor, and greatly in excess of that of Southport; that these towns had not been built with a special view to their sanitation, and had none of the great natural advantages possessed by Southport; that they in fact are places from which people should come to health resorts, in search of more perfect conditions of health, I maintain that the above statistics afford very strong proof that, at present, Southport does not, in reference to them, merit the reputation of a health resort. If I compare the death-rate of Southport with that of other health resorts, the result is still more unfavourable to Southport, I will only trouble you in this comparison with the average death-rate for the term 1879 to 1882; the average rate of thirty health resorts for this term equalled 16·2, and the average population equalled 20,000; the death rate of Southport equalled 19·4, and its average population 32,387. I should say the death-rate (16·2) is estimated too high for the health resorts, but it is made up to the last available moment, and has not been thoroughly elaborated. Should it be said that the low death-rate of other health resorts is due to their less populations, I may say that four (4) health resorts with the largest population, averaging 38,109, had an average death-rate of 17·1 for the same term. The diseases whose death-rates are more especially reliable as indicative of the sanitary condition of a town are typhoid fever, diphtheria, and scarlatina. I must content myself with merely quoting in comparative form the respective average number of deaths from these diseases for certain health resorts mentioned in my pamphlet on the sanitary condition of Southport, and for Southport, for the term 1879 to 1882:—

		Health resorts.	Southport.
Typhoid, average number of cases		14	25
Diphtheria	,,	3.2	18
Scarlatina	,,	12	35
		29.2	78

And I may state that for the last two years in Southport 16 deaths occurred from typhoid fever, representing 112 cases of sickness; 13 deaths from diptheria, representing 40 cases of sickness; 26 deaths from scarlatina, representing 204 cases of sickness. I think that as far as these statistics go I am justified in saying that up to 1882 the standard of health in Southport has not been what it should be as a health resort, and that its death-rate compared very unfavourably with other health resorts, and almost put it out of court at present as a health resort I wish now to show by a comparison of the death-rates of Southport before and after 1878, and by a comparison with the death-rates of Southport and other places for the same term, that Southport has not benefited by her new drainage system. In the years 1877 and 1878 the average death-rate of Southport was 22.8; for the year 1879-1880 the average death-rate of Southport was 21·8, thus a drop of 1 occurred, but then I find that the death-rate of the country for the same term dropped ·8 (nearly 1), and that the fifty large towns mentioned in page 91 of "the Registrar General's Reports" dropped ·7; and again I find that the death-rate of Southport for 1880, when the drainage had been two years in operation, equalled 22·9—the highest rate which had occurred for four years; and again I find that in the first quarter of 1883 the average death-rate of Southport reached the very high figure of 24·4—a death-rate in excess of the average rate (23·8) of towns with a population of 431,048. I cannot occupy your time further with elaborate statistics; but I would remark on the death-rates of the diseases which specially may be taken as tests of the sanitary condition of a town—viz, typhoid, diphtheria, scarlatina. As regards the typhoid fever death rate of Southport, though a drop of ·43 occurred in 1879, similar variations have taken place in this death-rate in Southport before 1878; these variations could not be due to the new drainage, which was not then laid. I don't, therefore, see any reason why the drop in 1879 should be attributed to its good effects and not to the unknown influences which produced a drop in 1877, and at other times, especially as there has been a steady tendency ever since in the typhoid fever rate to rise, until in the first half-year of 1883 it had reached the high rate of ·28, as against ·19 for England and Wales. The same applies to the diphtheria death-rates, 1873, '74, '75, '76. The death-rates from this disease equalled ·00, ·00, ·04 ·18; subsequent to 1878 the rates have been ·06, ·09, '18, ·20! so that a steady increase has occurred. The average diptheria death-rate for England and Wales in 1878-1882 equalled .11, for Southport it equalled ·13. The scarlatina death-rate is unfavourable to the supposition that Southport has benefited by her new drainage system. I give the rates for the years 1876, '77, '78: the rates are ·00, 07, and ·51; for the years 1879, 1880, '81, '82, the rates have been ·16, ·12. '34, ·44. In 1882 the Southport scarlatina rate of ·44 nearly equalled England and Wales rate of ·51. I think that the study of the death-rate before and after 1878 in Southport, and the other comparisons I have named, justify the assertion that Southport has not benefited, as far as these show, by her new drainage system! I will now show how it is impossible that a town situated as Southport is can be satisfactorily drained by a system of drainage such as that now in operation here. The present system is a combined system—it conveys sewage and surface water by the same system of pipes. The whole system comprises about nine miles of main sewers, laid in a bed of deliquescent sand. They are laid at gradients varying from 1 in 1,500 to 1 in 5,000. This is an inclination so small that were a piece of sewer pipe laid in this room, and were it to be adjusted to a gradient of 1 in 5,000 an adjustive screw would be necessary to lay it at such a small inclination, and then you would not perceive any deviation of the pipes from an absolute level. What hope can there be that a length of ten miles of sewer can be laid and maintained at such gradients in a shifting bed? The total length of the sewerage of Southport is about forty miles. But the necessarily slow flow of sewage through such a drainage system is altogether stopped twice in twenty-four hours by tide-locking of the whole system. The outfall is four and a half miles from the town. Along the great length of main sewers to the outfall the sewage of Southport slowly meanders.

An attempt has been made to increase the rapidity of the flow by the use of numerous penstocks or flushing gates, at intervals of 200 yards, on the length of the main sewers. The effect of these is to dam up the sewage for a time, and then, by opening the gates, to allow the accumulated sewage to act as a flushing force for the succeeding portion of sewer. I need not point out that this total stoppage of the sewage flow causes the solid part of the sewage, more or less, to deposit, coats the walls of the sewer with a coating of slime, which will decompose and evolve gas; and that the closure of the gates, by causing total stagnation for a time of the sewage, facilitates decomposition and the formation of gas. I have noticed that five flushing tanks have recently been built, with a capacity of 500 gallons a piece. It is proposed, I understand, that these tanks should discharge three times a day into Lord-street and Albert-road main-sewers 5,000 gallons of water per diem. *i. e.* each tank would be discharged twice a day; such a quantity of water can have no practical effect in flushing Lord-street sewer. The map and sections on the walls will help you better than anything else probably to understand the drainage systems of Southport. Drawing No. 1 is a map showing the main-sewers of Southport, their position and the number of their flushing chambers, &c. Drawing No. 2 shows the longitudinal sections of the three main sewers. Drawing No. 3 shows a longitudinal section of the main trunk outfall sewers, and it also shows where its equivalent in iron would be laid, if the pneumatic system were adopted; and Drawing No. 4 is a cross section showing the relative depth of the sewers placed on Drawing No. 3. The flow in the existing tributary sewers is aided, to a certain extent, by the intermittent use of portable flushing tanks, but the volumes of water discharged by them is infinitesimal in quantity compared with the amount necessary to flush sewers of their length and cablibre. These flat sewers are ventilated at the street level by grids communicating directly with the cavities of the main-sewers. So I think I may say, having regard to the gradients at which these sewers are laid, their disproportionate size to the amount of sewage to be conveyed, the necessary slow flow of that sewage, the flushing apparatus used to obviate the difficulties of the slight gradients, and the arrangements in use for ventilating them, that these sewers are very badly contrived for quickly, safely, and inodorously conveying the sewage from the town; that they are, in point of fact, well fitted for the formation, storage, and discharge of sewage-gas into its atmosphere. The sections on Drawing No. 2 show the different sizes of sewers which now constitute the main-sewers of Southport. I have marked their capacity and the velocity at which sewage will flow through them when full or two-thirds full, laid as they are at the gradients marked at each length. The sewers actually constructed are coloured brick-red. Immediately below these brick-red sewers you will notice a well-marked green-dotted line. This line indicates the gradients which would be suitable for the brick-red sewers, if the fluid passing into them is to travel at a velocity of two-and-a-half feet per second, when the sewer is charged one-third full. Below the existing brick-red sewers, and below the green-dotted lines—at which the existing sewers ought to have been placed—you will observe, I have shown, by a thick, heavy red line, the sewers as they ought to have been laid down if the sanitary authority at Southport had insisted at the onset upon having all their main sewers self-cleansing sewers. Let us take a section of the main sewer—a section in the neighbourhood of which sewage effluvia are greatly complained of. This is an egg-shaped sewer 36 inches by 24 inches; it is laid at a gradient of 1 in 1,500, and it receives the sewage of about 18,000 persons. Now, properly to convey the sewage of 18,000 persons as it is discharged, at various points, this part of the sewer should consist of successive lengths of pipes nine inches, ten inches, twelve inches, and fifteen inches in diameter, as shown upon the section; and these pipes should be laid at gradients ranging from 1 in 200 and 1 in 250, to 1 in 400. You will mark the contrast between what is and what ought to be. The reason the present main sewers are so outrageously large is that provision had to be made for backing, caused by the diurnal tide-locking of the whole system, and for the engorgement of the sewer, by rain and surface water. The reason it is laid at a gradient so much less than that which the necessity of the laws of hydraulics demand is because no better could be had. The result is that under ordinary circumstances the proper size of sewer, the gradient and proportional quantity of sewage being absent—which would cause the sewage to flow rapidly through a half full sewer—the sewage now meanders slowly along the bottom of a sewer very many times too large; it gives off sewage gases which collect in the great empty space of sewer above the sewage, and these are discharged through the grids into the air of the town; and when the locking of the sewers takes place, especially during heavy rains, large volumes of foul sewer-air would escape into the streets and force its way through defective drains and traps, thereby throw sewage gas into the dwellings of the town. I will merely add two facts which will show how impossible it is in Sonthport, from the flatness of the site, to lay a gravitation system of drainage at self-cleansing gradients, and to show what is the real relation of the sewage of Southport to the pipes which convey it. Had the sewers of Southport been of a size suitable for the conveyance of the sewage of the town, and had they been laid at self-cleansing gradients, you will see on reference to Drawing No 2 that the sewers would have been 55·6 on section No. 1; 66·4 on section No. 2; and 106·6 feet on section No. 3 below the invert of the present outfall sewer at Crossens. The sewage of Southport would have had to discharge itself these numbers of feet below the surface of the ground; and, again, to show the disparity between the size of the sewers provided and the quantity of sewage conveyed, I have made a rough computation of the number of cubic feet contained in the Southport main, tributary, and house sewers, and I find it amounts to 803,396 cubic feet. If a trough 1 foot square were made about 152 miles in length, it would represent the space provided for the sewage of Southport, and as the whole day's supply would barely at any time exceed on the average 180 cubic feet per minute, this latter quantity, if uniformly spread over the bottom of the trough 152 miles in length, would only be equal to the 1-374th part of an inch in depth. I think I have said enough to demonstrate the hopelessly inadequate nature of the drainage system in Southport, whether we consider the size of the sewers and the gradients at which they are laid, and the quantity of sewage available to charge them. And I would remind you of the nature of the bed in which they are laid. It is a deliquescent sand. But in treating of the conveyance of the Southport sewage through these great sewers, I have only dealt with part of the question of the drainage of Southport. The subsoil water stands at an injuriously high level from the surface. It stands at from 3½ to 4 feet, and it has been proved by analysis to contain a large proportion of decomposing organic matter. This is a serious danger to the sanitation of the town. It is necessary that this subsoil water should be lowered on sanitary grounds. I now propose to describe to you the system of combined hydraulic and pneumatic drainage, designed by myself, which will at once satisfactorily remove the sewage of the town, and deal with its subsoil water. The better to explain my system I will describe it as consisting of two parts, A and B. This system combines methods of drainage by gravitation and by pneumatic pressure. Under A, I shall describe the portion of this system before air-pressure is brought to bear on the sewage; and under B, I will describe the portion after that point. I then take a flat surface such as that of Southport. I divide this surface into areas; in each of these areas I sink a pneumatic sewage ejector, and this ejector, so to speak, is the centre of the application of pneumatics in my system. The A part of the system consists of an arrangement of sewage pipes which, by gravitation, convey the sewage of the area of which the ejector forms the centre to that ejector; but the speedy and practically safe and inodorous conveyance of the sewage to the ejector is provided for by the laying of the pipes at artificial gradients, and by the employment of hydraulic sewage ejectors and flush tanks, similar to that exhibited at work at the Skating Rink. The gradients are determined by the depth at which the pneumatic ejectors are sunk below the level of the surface of the ground, and they would vary from 1 in 100 to 1 in 200.

B, the pneumatic part of the system. The pneumatic ejector, of which there is a working model exhibited at the skating rink, is a cast-iron chamber, placed below the surface of its area in a manhole of the depth necessary to provide good gradients for the pipes which convey the sewage of the houses to it. It is provided with an inlet and an exit pipe; each pipe is supplied with a ball valve, which on one side prevents the regurgitation of the sewage into the house drains when it has once entered the ejector, and, on the other, prevents its return into the ejector when it has been expelled from it into the sealed iron main. The ejector is fitted at its upper part with an automatic apparatus which admits compressed air to expel its sewage contents. When the ejector is charged, the exit pipe of the ejector conveys the sewage as it is expelled from the ejector into an iron outfall sewer common to several or all of the ejector stations connected with the sewerage system. The left-hand part of the Section on Drawing No. 3 will illustrate the way in which the pneumatic ejectors and flush tanks would be employed, supposing the system of drainage designed by me was applied to Southport, in substitution of the present system. The pneumatic ejectors discharge the sewage as it gravitates to and fills them, and this they do automatically, irrespective of the distance which the sewage may have to travel from each ejector to the outfall; of course, the further the outfall is, even on a place perfectly flat, the greater will be the pneumatic pressure needed to eject the sewage, but the varying pressures required are readily adjusted in practice. It matters not for a town like Southport how many ejectors were employed, providing there were no more than were required; but if the engineer elected, for instance, to fix as many as forty ejector stations to sewer Southport, these, unlike ordinary pumping stations, would not require forty separate pieces of land as sites for the engines and boiler-houses—indispensably necessary in connection with ordinary pumping machinery. One site only would have to be purchased, and that would be for the air-compressing stations, but the forty ejector stations would be under the streets, and controlled by the men in attendance at the one engine station—*i.e.*, at the air-compressing station. Allow me to trace the sewage of an area through the system. The artificially graded house-drains and tributary sewers, as already stated, discharge their contents into the ejector of the area to which they belong. The sewage passes into the ejector till it rises to a certain level in it; its upward pressure acts upon an apparatus which, by opening a valve, admits a rush of compressed air—supplied to it from the air-compressing station—through small iron pipes laid under the streets, like our gas pipes, and made to communicate with each ejector. This air, when admitted, forcibly strikes the surface of the sewage in the ejector, and by its continuous force closes the ball valve on the inlet pipe, and at the same moment forces the sewage through the exit, out of the ejector, into the sealed iron exit pipe; through this, in due course, it reaches the outfall. The same process is repeated with the whole sewage of the district; the force applied discharges it quickly, safely, and inodorously at pressures determined by the amount of air force necessary to expel it out of each of the ejectors. In the section on Drawing No. 3 two ejectors only are shown, and these are numbered 39 and 40. No. 40 is the last of the lot, and it is supposed to throw the sewage, say of 1,000 people, into the iron outfall sewer, which, you will observe, is only 17 inches in diameter. At Station No. 39, however, the iron outfall sewer is only 15 inches in diameter. The advantages of this system are—1. For its successful working it is independent of the natural conformation of the district sewered by it, because the gradients of the A or gravitation portion of the system are determined artificially by the depth at which the area ejector is sunk beneath the surface. The drains of this portion are always laid, therefore, at self-cleansing gradients of from 1 in 100 to 1 in 200. 2. When the sewage has once entered the ejector, it passes into B, or the pneumatic portion of the system. This portion is sealed, and any escape of sewage or sewage gas thenceforth is impossible, because the sewage is discharged at once into an iron outfall sewer, on which there are no manholes or ventilators to annoy the public. 3. The action of this system is automatic. The only part which reqnires special attendance is the engine for compressing the air. 4. If a fault occurs in any part of the system, the faulty point can soon be detected and the fault remedied. If Southport was sewered upon this semi-pneumatic and semi-hydraulic system, the sewage would be rapidly, effectually, and inodorously conveyed from the town in sealed iron mains to any outfall or outfalls which may be deemed desirable, and the sewage, being discharged in a condensed form, could be utilised as liquid manure. The sub-soil water, now a source of danger to health, from its high level and impure condition, would be drained, its level lowered, and it would be discharged along with the rainfall into the present system of sewers. When all sorts of contamination from faulty sewerage had been removed, the subsoil water would in a short time run itself clear, and might be used for street watering and for cleansing purposes in the town.

Such is the case of Southport, I have demonstrated to you the present grave defects in the sanitation of this health resort, and I have, I trust, convinced you that, by the adoption of my system of drainage, the defects pointed out would be removed. These remarks have, of course, a catholic application. What I have said as to the difficulty of draining Southport and the defects of the Southport drainage system applies to all towns so built on flat sites. The dangers which threaten, and the sewage gas nuisances which arise in places so drained, are the same. I venture to submit that I have in my semi-hydraulic and semi-pneumatic system of drainage proposed a method which will effectually solve the problem of draining places which do not possess the natural conditions for drainage by gravitation. I would, in conclusion, thank you very much for the patience with which you have listened to me, and would remind you that an iron hydraulic house ejector, as well as a working model of the pneumatic ejector, was during the Association week seen at the machinery showroom at the Winter Gardens, and that the system is already in successful operation at Eastbourne, Warrington, and elsewhere. I may also add that, as the result of the satisfaction with which the working of the system is regarded at Eastbourne, the sanitary authorities there have just ordered a third pneumatic station, and I am pleased to say that a number of other sanitary authorities are about to apply it to their towns and districts.

RECENT AMERICAN AND FOREIGN PATENTS.

Messrs. S. H. Knapp and A. E. Adams, of Danbury, Conn., have patented a novel and ingenious elevated wire railway for carrying mail, dispatches, &c. Small cars run on wires which are supported on posts in the same manner as telegraph wires. The cars are propelled by a small electro-motor which receives its electric current from a battery on one of the cars.

A device for operating air compressor vaives which obviates the necessity of employing spring valves, which are apt to get out of order and which enables the cylinder to be more properly filled, has been patented by Mr. Charles A. Bennett, of Dover, N.J. This device opens and closes the inlet valve of the compressor automatically, and is operated at the same time by the machinery of the compressor.

Mr. Oakley S. Walker, of Carthage, N.Y., has patented a ratchet drill having the working lever provided with a boss or socket which forms a bearing for the feed mechanism may be extended and utilized the full length of the drill spindle.

Mr. Eratus B. Barker, of New York city, has obtained a patent for an improved manner of mounting a photographic camera box upon a circular support; the object of the invention being to enable the box to be readily reversed and adjusted to any desired position, so that pictures of different horizontal and vertical lengths may be taken.

A patent has been granted for a mechanism for raising lines to the upper parts of buildings to enable ladders or other escape mechanism to be elevated in case of fire. This mechanism is designed to be clamped to the top of a ladder or telegraph pole, and by manipulating the crank a long rod bearing one end of the rope at its extremity will be elevated until the window or roof from which the people are desiring to escape has been reached. Mr. George O. Daw, of New York city, is the inventor of this device.

A machine for preparing batches for glass furnaces, and also for promoting thoroughness in the preparation of such batches, has been patented by Mr. George S. Crotts, of Philadelphia, Pa. The invention consists in a batch mixer constructed with a series of elevators, and a box and a discharge slide, and spouts for introducing the materials into the mixing cylinder, where it is thoroughly mixed and then discharged upon the screen, so that the material will be mixed and screened with one handling.

Mr. Benjamin E. Sergeant, of Greensborough, N. C., has obtained a patent for an improvement in the maner of adjusting logs to the saw in saw mills. In this invention the log may be adjusted on the carriage in such a way that either end may be moved forward with an equal adjustment. The machine is so constructed that the workman, without moving from his position, may attend to the adjustments of the different parts, the setting of the log beams separately or together, the reversal of the movement of the log carriage, the adjustment of the saws, &c.

An improved saddler's sewing horse has boen patented by Mr. Joel Thomas Ward, of Piedmont, W. Vs. The invention consists in a sewing horse constructed with a fixed jaw and a pivoted jaw connected by a spring, the lower end of which pivoted jaw is connected bp a connecting rod with an arm of one end of a pivoted foot lever, which can be locked in position by passing the edge of a plate on the lever under the teeth of a rack secured on one of the legs. A rod provided at its upper end with a hook bend passes loosely through the bench, and can be locked in the desired position by means of a suitable binding screw, which rod serves to support the work.

A cotton cleaner and feeder for removing sand, stones, leaves, and other refuse from seed cotton previous to ginning, has been patented by Mr. A. J. Williams, of Macon, Ga. This saves the labour of picking stones from the cotton by hand, which is necessary when it is cleaned only a fan. As the cotton passes from the feeder it is carried between the beater and the apron, which operation loosens the cotton and permits the stones and stand to fall through openings prepared for the purpose in the apron. The cotton then passes into a trunk, when it is carried up by a fan over a suitable roller, while the stones and heavy refuse pass down and collect in a suitable receiver. The same inventor has further secured a patent for an improved rib for cotton gins to prevent seeds and other refuse from collecting in the space between the ribs and preventing the proper action of the saws. This improved rib is beveled on the front side and the opening is flared forward toward the upper end, so that the faulty seeds and lint are allowed to slip up and out, thus keeping the space clear and free.

A combined cultivator and planter has recently been patented by Mr. John B. Newsom, of Near Eufaula, Ala, This implement is provided with a plough at the front for opening the furrow, and with a hopper and a star shaped wheel located within the hopper for regulating the distribution of the seed in the furrow, and it is further provided with two pairs of plows at its rear end' which serve to cover up the furrow when the seed has once been deposited therein. One plough of each pair may be detached in case one horse is to be used and it is necessary to lighten the draught.

An improved grain separator has been patented by Mr. William Crain, of Castroville, Cal. This invention relates to that part of a grain separator which effects the first separation of the straw from the grain before the delivery of the grain and chaff to the shaking shoe. The separator has two screens arranged in the same plane at a distance from each other, and combined with suspending arms and a rake for continuing the passage of the straw from one to the other, and a reversely-geared pitman for giving opposite oscillatory movements to the screens.

NEW RAILWAY RAIL AND RAIL JOINT.—This rail consists of a hollow steel cap of less height than the ordinary rail, with a base of about the usual breadth. The bottom part of the rail is of iron, having a flange at the upper and lower side, and having along the upper side a rib over which the steel part of the rail fits. There is in each side of the lower part of the rail a deep groove in which are placed steel splice bars at the rail joint. These bars are slotted to admit of fastening them by means of spikes driven through both members of the rail. It is designed to arrange the two parts of the rail so as to break joints, and the re-enforcement of the rail at the joints by the splice bars makes it as strong, if not stronger, at these points than anywhere else. This invention has been patented by Mr. Peter A. Locke, of Silver Cliff, Colo.

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